BULLETIN OF STOMATOLOGY AND MAXILLOFACIAL SURGERY
Volume 21, Issue 12

DOI: 10.58240/1829006X-2022.21.12-421

ORIGINAL RESEARCH

EVALUATION OF TMJ ARTHROSCOPY WITH HYALURONIC ACID INJECTION VERSUS STAND- ARD TMJ ARTHROSCOPY FOR PATIENTS WITH INTERNAL DERANGEMENTS: A RANDOMIZED CLINICAL TRIAL

Mojamel Abdullah Al Affari[1], Bahaa Eldine Abdrabo Tawfik[2],Wael Ahmed El Mohandes[3]

[1] BDS, Faculty of Dental Medicine, Constantine University, Algeria, Master's degree, 2019, Faculty of Dental Medicine (Boys, Cairo), Al Azhar University, Egypt

[2] Professor of Oral and maxillofacial surgery, Faculty of Dental Medicine (Cairo- Boys), Al-Azhar Uni- versity, Egypt, Head of oral and maxillofacial unit in Sayed Jalal University hospital, Egypt

[3] Professor of Oral and maxillofacial surgery, Dean of faculty, Faculty of Dental Medicine (Cairo- Boys), Al-Azhar University, Egypt

Corresponding author: Mojamel Abdullah Al Affari BDS, Faculty of Dental Medicine, Constantine University, Algeria, Master's degree, 2019, Faculty of Dental Medicine (Boys, Cairo), Al Azhar University, Egypt

Received: *Nov 14. 2025;* ***Accepted:*** *Dec 25, 2025;* ***Published:*** Jan. *30,* 2025

Abstract

Background: Initial Temporomandibular joint (TMJ) arthroscopy aims to reduce inflammation and mechanical ob- struction in TMJ internal derangement. Supplemental hyaluronic acid (HA) deposition is frequently employed to improve joint lubrication and protect articular surfaces, yet its long-term therapeutic impact as an adjunct is not well-defined.
Objective: While TMJ arthroscopy is a standard treatment for TMJ internal derangements(ID), the added therapeu- tic value of HA as an adjunct remains unclear.
Study Design: Randomized controlled trial with 1:1 allocation. Setting: Patients with TMJ ID was selected from those attending the Outpatient Clinic of Oral and Maxillofacial Surgery Departement at Sayed Galal University Hospital, Al Azhar University and Faculty of Dental Medicine ,Boys, Cairo Al Azhar University
Participants: twelve patients over 18 years of both sexes, suffer from TMJ ID which not respond to conservative treatments, were randomized into two groups, study group(n= 6) patients and control group (n=6)patients. **Interventions**: Participants receive either standard TMJ arthroscopic lysis and lavage (ALL) alone (Control Group) or the same ALL supplemented with an intra-articular injection of HA (study Group). Both protocols were per- formed under general anesthesia for patients diagnosed with TMJID.
Main Outcome Measures:, including pain levels according visual analog scale (VAS) and maximal interincisal opening (MIO), laterality excursion, protrusion, chewing efficacy and disc position change in MRI, were assessed between groups at standard follow-up intervals
Results: Both groups showed significant pain reduction, but HA group reported significantly lower pain at 3 months (2.00 vs. 4.33, p = 0.016) and 6 months (1.33 vs. 4.33, p = 0.005), No statistically significant differences were ob- served between the groups for any additional parameters throughout the follow-up period (p>0.05), with both co- horts demonstrating comparable improvements in maximal incisal opening (MIO).
Conclusions: TMJ arthroscopy effectively treats ID, with adjunctive HA providing superior early pain relief and functional recovery. However, long-term functional outcomes are comparable to standard arthroscopy alone. While HA accelerates initial healing, standard arthroscopy remains a highly reliable definitive treatment.

Keywords: Temporomendibular joint, internal derangement, Arthroscopy, hyaluronic acid, pain.

INTRODUCTION

The temporomandibular joint (TMJ) is a ginglymodiarthroidal joint; having both rota- tional and translational movements. This joint is formed of the mandibular condyle fitting into the mandibular fossa of the temporal bone. Where the articular disk separates these tow bones [1].

Moreover, the temporomandibular dis- orders (TMDs) are considered as the most com- mon causes of non odontogenic pain in the max- illofacial region, affecting the TMJ itself as well as the associated anatomical structures [2]. About 10 millions of populations suffering from TMDs in the USA as well as treated in studies [3]. Alt- hough Seventy-five percent of adults show at least one sign of joint dysfunction during exami- nation and one third have at least single clinical symptom [4].

Diagnosis of the TMDs is reached through anamnesis however the clinical exami- nation concomitantly with using of imaging techniques which increase the accuracy of the diagnosis. Magnetic resonance imaging (MRI) is accepted as the gold standard diagnostic aids of non calcified structures of the TMJ.[5]. There was a variety of classifications, 1989, Wilkes [6] first established a classification which consists of 5 stages depending on the clinical, radiologic, and intraoperative findings. Besides, most inter- nationally used diagnostic tools during the last two decades have been the Research Diagnostic Criteria for TMD (RDC/TMD) and the TMD classification according to the American Acad- emy of Orofacial Pain [7,8].

In concern management of TMDs con- sists of non invasive treatment which includes patient education, prescription of medications, physical therapy and occlusal appliances. Many patients recover with only jaw rest and soft diet, while others may require a combination of these non invasive treatments [9].

Arthrocentesis is a minimally invasive treatment often used in patients who do not re- spond to conservative treatment to relieve symp- toms that impair the quality of life has inspired many studies. [10] Arthrocentesis is minimally invasive, inexpensive and highly effective pro- cedure, apart from having a low morbidity rate[11]. It invalues because arthrocentesis does not involve visualization of the joint structures or the use of additional surgical manipulations, it raises the question of whether arthroscopy should be the preferred initial treatment TMDs.[12] TMJ arthroscopy was first performed by Wanatabe M.[13], a Japanese orthopedic sur- geon. After that, Holmlund et al.(14) popular- ized TMJ arthroscopy. Since then TMJ arthros- copy became a widely popular, leading to open surgical treatment for TMD is now uncommon, and is reserved for specific indications as well as end-stage diseases, ankylosis and removal of tumour among others [15].

Arthroscopy may be finished with intra articular injections, many different substances that can be injected following TMJ arthroscopy to enhance the best possible clinical re- sults.(16)Among these substances hyaluronic acid (HA) and platelets rich plasma(PRP). The HA is a glycosaminoglycan, naturally present in synovial fluid and participating in joint lubrica- tion, that is produced by chondrocytes and syno- viocytes within any joint [17,18].

Therefore, the main objective of this study was to evaluate the effectiveness of HA injection following operative arthroscopy, com- pared with the conventional TMJ arthroscopy, in patients with (TMJID).

PATIENTS AND METHODS

Study Design: This study was designed as a ran- domized, parallel-arm clinical trial with a 1:1 allocation ratio. The primary objective was to test the null hypothesis that no statistically sig- nificant difference exists in HA deposition be- tween TMJ ALL supplemented with HA versus standard TMJ ALL alone. Ethical clearance was obtained (Approval Code: [Code]) before the study commenced, and the trial was retrospec- tively registered at ClinicalTrials.gov (Identifier: 884/1960). This report adheres to the updated CONSORT guidelines for randomized clinical trials

Participants

Inclusion criteria: Patients over 18 years of both sexes. Patients with a diagnosis of TMJID according to Wilkes classification of TMDs. Patients who did not respond to conservative treatment as a first line of treatment.

Exclusion criteria comprised Patients with polyarthritis or degenerative joint disease. Patients with myo- fascial pain, Previous TMJ surgery, Uncon- trolled systemic diseases contraindicating gen- eral anesthesia or surgery. Ankylosis, intra- articular tumor spread, overlying skin infections. Lactating, pregnant or planning pregnancy women. Known hypersensitivity to HA. Inabil- ity to attend follow- up appointments. Prior to enrollment, written informed consent was se- cured from all participants. a sample of n=5 per group was required to detect an effect size of d=2.18 alpha=0.05, power=0.80. Adjusting for a 20% dropout rate, the total sample size was set at n=12 (6 per group).

Randomization and blinding

An independent assistant, uninvolved in re- cruitment or study procedures, generated the random allocation sequence (1-12). Each num- ber was sealed in an opaque envelope, which were then shuffled. Immediately prior to sur- gery, the envelope was opened to reveal the as- signed surgical technique.

Interventions

Preoperative phase: Clinical parameters, in- cluding pain, , and functional range of motion— specifically maximal interincisal opening (MIO), contralateral lateral excursion (LE), and protru- sive movements, chewing efficacy were record- ed for all patients. Additionally, Magnetic Reso- nance Imaging (MRI) was performed to evaluate disc position and joint morphology.Figures1(a,b)

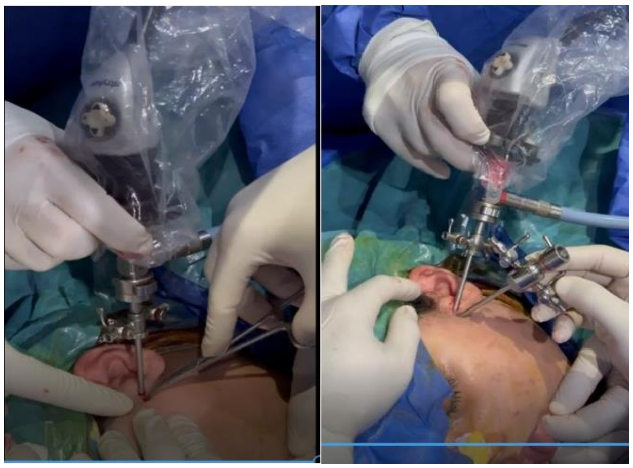

Figure1 a. posterior portal for inflow, arthroscope camera.
Figure1 b. two portals were established inflow and outflow.

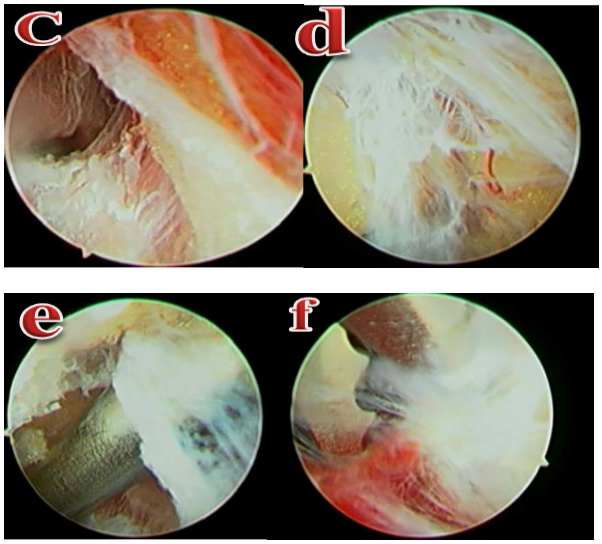

Figure 2 c,d,e,f intra articular image showing poste- rior recess, adhesion and synovitis, outflow sheath and grasper head.

A rigid endoscope with an outer diameter of 2.4mm and a 30° viewing angle (Karl Storz SE & Co. KG, Tuttlingen, Germany) was used for the procedure. All patients underwent arthroscopy under general anesthesia. the portals for inflow and outflow are established along the Holmlund-Hellsing line.(14) (cantho-tragal ligne). After occluding the external auditory ca- nal with sterile cotton, the surgical field was scrubbed and draped using standard sterile tech- niques. Entrance points was located along the canthotragal line, The primary inflow/fossa puncture was marked 10 mm anterior to the tra- gus and 2 mm inferior to the line. The secondary outflow portal was marked 20 mm anterior to the tragus and 10 mm inferior to the line.(21)

In a supine position with the head rotat- ed, the superior joint space was distended (3 mL saline/2% lidocaine) and backwashed. each pa- tient received a double portal puncture (level II arthroscopy), Using a 2.4 mm trocar-cannula sheath, a primary portal was established; place- ment was confirmed by saline fluctuation during jaw movement before inserting a 2.3 mm ar- throscopy. Figure (a) An anterolateral second portal was created for outflow and instrumenta- tion. Figure2(b) Lysis and lavage were per- formed using 500 ml Ringer's lactate, delivered via an infusion pump through the primary can- nula. This maintained continuous pressure to facilitate adhesiolysis and the drainage of inflammatory mediators through the outflow portal.

Control group: Lysis and lavage Ringer's lac- tate alone.

Study group: Lysis and lavage with Ringer's lactate. Deposition of 20 ml of HA post ALL. Stab incision were closed with 5-0 sutures and dressed. Following 5–10 assisted maximal mouth opening repetitions, patients were extu- bated.

Postoperative management

a preauricular pressure dressing was applied for 48 hours. Patients received amoxicil- lin/clavulanic acid (625 mg) and an analgesic complex (ibuprofen 400mg/paracetamol500mg). Cryotherapy was used for 24 hours (20-minute intervals), followed by moist heat. The diet pro- gressed from liquid to soft over three months. Occlusal splint therapy and physiotherapy (ver- tical/lateral exercises) commenced at 24 hours. Sutures were removed after one week

Observation and follow-up

Clinical assessments were conducted at baseline and postoperatively at 1 and 2 weeks, and 1, 3, and 6 months.

Parameters included

- Pain: Evaluated via Visual Analogue Scale (VAS) daily for the first week, then at each follow-up interval.
- Mandibular Kinematics: MIO, lateral excursion, and protrusion were meas- ured using Vernier electronic calipers.
- Functional Outcomes: Chewing efficacy was evaluated using a 3-item food ques- tionnaire (liquid, soft, and hard foods).
- Radiological Evaluation: Preoperative MRI findings were compared with fol- low-up scans obtained at 6 months. Figures (i,g).

Statistical Analysis

Descriptive statistics are reported as mean ± SD, median (IQR), or counts (%). Data normality was confirmed via Kolmogorov-Smirnov test (D=0.13532, p=0.894). Continuous variables were analyzed using independent t-tests for in- ter-group comparisons. Analysis was performed via IBM SPSS v.21, with significance set at $p < 0.05$.

RESULT

Demographic Data

The mean age for Group I was 28.67 years (SD = 10.03), while for Group II, it was 30.17 years (SD = 7.08).The ages range from 21 to 48 and 23 to 41 for both groups respectively. Regarding gender distribution, in Group I, 5 out of 6 participants (83.3%) were female, and 1 (16.7%) was male. In Group II, all 6 participants (100%) were female. There were nonstatically significant between both groups as regard age and gender (table 1). With a P value of 0.771 for age and 0.296 for gander.

Preoperative VAS scores were compa- rable between groups for both right ($p = 0.271$) and left ($p = 0.210$) TMJs. While no significant differences occurred in early follow-ups, Group I (HA) demonstrated significantly lower pain at 3 and 6 months bilaterally (all $p < 0.05$)Table(1). Specifically, at 6 months, HA scores were mark- edly lower for both right (1.33 vs. 4.33, $p = 0.005$) and left TMJs (1.17 vs. 4.00, $p < 0.001$), indicating superior long-term pain reduction with HA injection table 1. Preoperative MIO, lateral excursion, and protru. sion were comparable between groups ($p > 0.05$). For MIO and lateral excursion, no sta- tistically significant differences were observed at any postoperative interval up to 6 months ($p = 0.078$–0.975), despite slight trends favoring Group I at 3 and 6 months.

In contrast, Group I (HA) demonstrated significantly greater protrusion during the early postoperative phase: Day 1 ($p=0.030$), Day 2 ($p=0.001$), and Day 3 ($p=0.045$). However, this advantage diminished over time, with protrusion scores remaining statistically similar from 1 week through 6 months ($p = 0.205$–0.783).

Table 1. Pain comparison between two Groups, VAS)

VAS score for Pain	Group I (n=6)	Group II (n=6)	Test value	P-value
Right				
Pre Op.	8.47±0.59	8.17±0.23	1.166	0.271
1st	9.00±0.89	8.75±0.76	0.522	0.613
2nd	8.10±0.79	8.00±0.63	0.243	0.813
3rd	7.67±0.82	7.17±0.41	1.342	0.209
4th	7.33±1.03	6.85±0.97	0.837	0.422
5th	6.50±1.22	6.83±1.33	-0.452	0.661
6th	6.17±1.17	6.25±0.61	-0.155	0.880
7th	6.00±1.67	6.25±1.08	-0.307	0.765
2w	4.33±1.21	4.83±1.72	-0.483	0.640
1M	3.50±0.98	4.08±1.43	-0.656	0.527
3M	2.00±0.56	4.33±1.03	-2.907	0.016*
6M	1.33±0.37	4.33±1.21	-3.614	0.005*
Left				
Pre Op.	7.92±0.68	7.33±0.82	1.34	0.210
1st	8.25±0.76	8.08±0.66	0.405	0.694
2nd	7.72±0.47	7.50±0.45	0.817	0.433
3rd	7.42±1.02	7.00±0.63	0.85	0.415
4th	6.42±0.49	6.00±1.10	0.85	0.415
5th	6.23±0.43	5.67±1.03	1.24	0.243
6th	6.00±0.00	5.67±1.37	0.598	0.563
7th	4.67±0.74	6.00±1.41	-1.195	0.260
2w	3.33±0.93	4.83±1.33	-1.671	0.126
1M	3.00±0.84	4.00±1.10	-1.225	0.249
3M	1.67±0.47	3.83±1.17	-2.951	0.014*
6M	1.17±0.33	4.00±0.89	-4.715	<0.001**

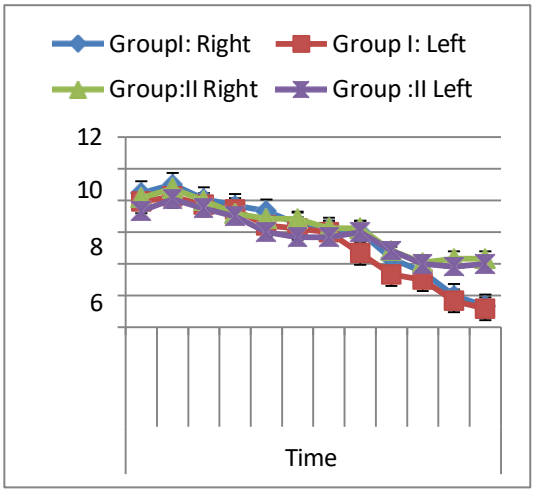

Figure. 3 Comparison between two groups according to VAS score for pain.

Preoperative and early postoperative chewing efficacy were identical, with both groups re- stricted to soft foods at baseline and liquid diets through Day 6 (p = 1.000). By months 2 and 3, Group I (HA) showed a trend toward faster re- turn to hard foods (83.3% and 100%, respective- ly) compared to Group II (50% and 66.7%), though these differences were not statistically significant ($p \geq 0.121$).

Baseline and postoperative MRI find- ings showed no significant differences between groups bilaterally ($p > 0.05$) table2.

Table 2. Comparison between Group I and Group II according to MRI.

MRI find- ing	Group I (n=6)		Group II (n=6)		Test value	P-value
	No.	%	No.	%		
Right						
Pre						
DDWOR	4	66.7%	6	100.0%	2.400	0.121
DDWR	2	33.3%	0	0.0%		
Post						
DDWOR	3	50.0%	4	66.7%	0.343	0.558
DDWR	3	50.0%	2	33.3%		
Left						
Pre						
DDWOR	4	66.7%	2	33.3%	1.333	0.248
DDWR	2	33.3%	4	66.7%		
Post						
DDWOR	1	16.7%	1	16.7%	0.000	1.000
DDWR	5	83.3%	5	83.3%		

Preoperatively, disc displacement with- out reduction (DDWOR) was the predominant finding. Postoperatively, both groups demon- strated similar transitions to disc displacement with reduction (DDWR); on the right side, Group I improved to a 50% DDWR rate com- pared to 33.3% in Group II (p = 0.558), while on the left side, both groups achieved identical out- comes with 83.3% reaching DDWR (p = 1.000). These results indicate that both treatment modal- ities were equally effective in improving disc position

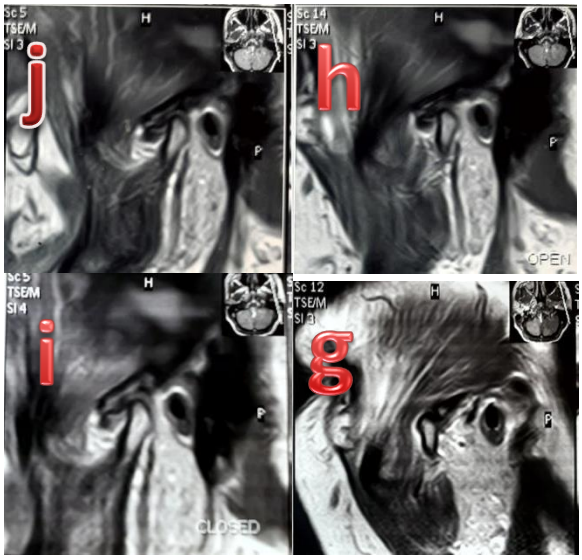

Figure4 j,h MRI closed and open preoperative **Figure 4** i,g MRI closed and open postoperative

DISCUSSION

The primary objective of this research was to assess the efficacy of HA deposition post TMJ ALL versus TMJ ALL alone in achieving superior pain relief, MIO, laterality excursion ,protrusion, chewing efficacy and MRI improvement changes six months post-arthroscopic procedure.

Both groups were demographically comparable, with no significant differences in age, both showed a strong female predilection. This baseline homogeneity ensures that subsequent outcomes are attributable to the intervention rather than demographic variables.

Epidemiological research indicates a significant female predilection in TMJ disorders. Despite extensive investigation into hormonal influences, psychosocial stressors, and genetic predispositions, the exact mechanisms driving this demographic trend remain not fully introstod this result was in accordance of study perfomed by Bagis B.[18] While literature suggests that TMJ disorders peak between the ages of 20 and 40 Manfredini et al.[19].The

results of this study mirrored this distribution, with 83% of participants in their second through fourth decades and an average age of 33.9 years.

In this study using HMW of HA, The HA binds to cell receptors to modulate immune responses and suppress inflammatory cascades, effectively reducing joint pain. Additionally, it acts as a biological shock absorber, cushioning joint structures by distributing mechanical loads [20].

Preoperative pain was comparable across all joints. While most follow-up intervals showed no significant differences, the HA group demonstrated superior long-term pain relief at 3 and 6 months. In both sides, pain scores were significantly decreased. These findings suggest that while arthroscopy provides initial relief for both groups, the addition of HA significantly enhances and sustains pain reduction over time. The HA exerts an analgesic effect by desensitiz- ing intra-articular nerve endings. This finding align with previous controlled studies, which similarly reported significant improvements pain 21.

This was in accordance of Morey-Mas MA [22]. The HA injections following ALL ob- served a significantly enhancement of pain re- duction and TMJ function compared to Ringer's lactate. This finding was not supported across a systematic review performed by Xie et al. [23] In terms of pain reduction, there is no significant difference between HA and placebo, regardless of the follow-up duration.

While both study cohorts experienced a reduction in TMJ pain, the HA group demon- strated significant pain reduction across 3 and 6 month of follow up. These findings reinforce the hypothesis that HA exerts independent analgesic and anti-inflammatory effects that complement
the mechanical benefits of arthroscopic lavage and debridement.

As regard the MIO, and lateral excur- sions improved significantly in both groups with no statistical difference between them. While Group I (HA) experienced a significant boost in protrusive movement during the first three days post-op, this benefit subsided by one week, resulting in similar long-term outcomes for both techniques. this was in agreement with Castaño Joaqui et al.[18] and Morey-Mas et al. [22] who demonstrated tha does not establish the clinical superiority of HA injection post ALL compared with ALL alone. The observed improvements may stem from a multimodal ap- proach involving arthroscopy, adjunctive medi- cations, and physiotherapy.

In contrast, Stasko et al. 24 demonstrated that combining arthroscopy with HA injection significantly reduces pain and restores oral opening. This dual approach effectively debrides adhesions while flushing inflammatory mediators to enhance joint mobility.

HA reduces inflammation and prevents adhesion recurrence. By restoring joint lubrica- tion and protecting cartilage, HA effectively modulates granulation tissue to improve long- term surgical outcomes [25].

Regarding chewing efficiency, findings indicate that Preoperative and early postopera- tive chewing efficiency was identical across groups, with all patients restricted to soft foods at baseline and liquid diets through Day 6. By one month, both groups successfully returned to soft foods . By months 2–3, Group I (HA) showed a clinical trend toward faster recovery, reaching 100% hard food consumption compared to 66.7% in Group II. Although HA may accelerate chewing efficacy, the lack of statisti- cal significance ($p = 0.221$) necessitates larger confirmatory studies.

Chewing efficacy is a key metric for as- sessing TMJ ID and recovery from TMJ arthros- copy. While TMJ ID patients typically suffer from impaired muscle activity and reduced chewing efficacy, Following TMJ arthroscopy, significant improvement typically occurs rapidly within the first 4 to 6 weeks, Most patients can tolerate soft and medium food textures with minimal pain or discomfort during chewing [26].

MRI evaluation demonstrated that both groups had similar types of disc displacement preoperatively. Postoperative imaging showed improved disc positioning (from DDWOR to DDWR) in both groups, with no significant in- ter-group differences, with no statistically signif- icant differences between the groups. This indi- cates that HA injection did not significantly alter the disc position outcomes achieved through TMJ ALL alone. This finding was aligned with that reported Silva et al.[27] He demonstrated that 63% of patients achieved an improved disc position following ALL. Despite the MRI find- ings in this study conflicting with by Gabler, M.J., et al [28]. This suggests that restoring disc mobility and functional dynamics is clinically more significant than achieving anatomical re- positioning of the disc [29].

Regarding intra operative complications, fluid extravasation represents the most common intraoperative finding, minor bleeding is also routine and generally controlled via pressure and irrigation, This outcome corroborates the find- ings of González-García R et al. [51]. Within the study group, neurological complications were documented in two cases, involving numbness in the left temporal region and motor weakness the right eyebrow respectively. Within the control group, one subject of left temporal

paresthesia was documented. Both the sensory deficit and motor weakness achieved complete resolution within 4 to 8 weeks ,the management was fol- lowing a regimen of Vitamin B12, corticosteroids, and physical therapy during the follow-up periods [52]. The close anatomical proximity of the auriculotemporal nerve and the temporal and zygomatic branches of the facial nerve to the arthroscopic portals renders them susceptible to injury. Mechanical compression or direct trauma from the cannula may result in transient neuro- logical deficits, manifesting as paresthesia or paresis [53].

Limitations of this study include a small sample size, which restricts generalizability, and a six- month follow-up, which precludes assessment of long-term joint stability or late-onset degenera- tion. Furthermore, Wilkes stage heterogeneity may have confounded results, necessitating stage-specific stratification in future research.

CONCLUSION

While TMJ arthroscopy with HA offers superior early-term analgesia and acceler- ated protrusive recovery, long-term functional and structural outcomes-including disc posi- tion and chewing efficacy are comparable to standard arthroscopy. Both modalities significantly improve mandibular mobility and edema over six months. Thus, HA serves as a beneficial adjunct for immediate postoperative recovery, but standard arthroscopy remains an equally ef- fective definitive treatment for TMJID.

DECLARATION

Conflict of interest

Authors declare that there is no conflict of interest .

Source of funding

There are no funds procured

REFERENCES

1.Wadhwa S, Kapila S. TMJ disorders: future innovations in diagnostics and therapeutics. J Dent Educ. 2008;72:930-47.

2.Polat M, Yanik S. "Efficiency of arthrocen- tesis treatment for different temporomandibular joint disorders." Inter J Oral Maxillofac Surg. 2020; 49: 621-27.

3.Lai Y, Yap A, Türp J. Prevalence of tem- poromandibular disorders in patients seeking orthodontic treatment: a systematic review. J Oral Rehabil.2020:47; 270-80.

4.Hossamelden R , McCain J. Outcomes of office- based temporomandibular joint arthrosco- py: a 5- year retrospective study. Inter J Oral Maxillofac Surg, 2018; 47: 90-97.

5.Abbasgholizadeh Z, Evren B, Ozkan Y. Evaluation of the efficacy of different treatment modalities for painful temporomandibular disor-ders. Inter J Oral Maxillofac Surg. 2020; 49: 628-35.

6.Wilkes CH. Internal derangements of th tem- poromandibular joint: pathological variations. Arch Otolaryngol Head Neck Surg. 1989;115:469–77.

7.Whyte M, McNamara D, Rosenberg I. Whyte A. Magnetic resonance imaging in the evalua- tion of temporomandibular joint disc displace- ment—a review of 144 cases. Int J Oral Maxillo- fac Surg. 2006;35:696– 703.

8.Dimitroulis G. A new surgical classification for temporomandibular joint disorders.Int J Oral Maxillofac Surg. 2013; 42: 218–22.

9.Asendorf A et al. Interexaminer reliability of the German version of the DC/TMD. J Oral Re- hab. 2021; 48: 28-34.

10. Goddard G, Mauro G. Temporomandibular disorders, a review of current diagnosis and treatment. Dent Cadmos. 2018;86: 364-75.

11.Monje-Gil F, Nitzan D, González-Garcia R. Temporomandibular joint arthrocentesis. Re- view of the literature. Med Oral Pathol Oral Cir Bucal. 2012;17:575-81.

12.Grossmann E . Poluha L. Comparison be- tween TMJ arthrocentesis techniques with dif- ferent needle positions: A randomized single- blind controlled clinical trial. J Cranio- Maxillofac Surg, 2021, 49.5: 368-72.

13.Watanabe M. Memories of the early days of arthroscopy. Arthroscopy. 1986;2(4):209-14.

14.Holmlund A, Axelsson S. Temporomandibu- lar arthropathy: correlation between clinical signs and symptoms and arthroscopic findings. Int J Oral Maxillofac Surg. 1996;25:178-81.

15.LASKIN, D. Arthroscopy versus arthrocen- tesis for treating internal derangements of the temporomandibular joint. J Oral and Maxillofac Surg Clin, 2018;30: 325-28.

16.Sakalys D, Dvylys D, Simuntis R, Leketas M. Comparison of Different Intraarticular Injec- tion Substances Followed by Temporomandibular

Joint Arthroscopy. J Craniofac S urg. 2020;31:637-41.

17.Hosgor H. Is arthrocentesis plus hyaluronic acid superior to arthrocentesis alone in the treatment of disc displacement without reduction in patients with bruxism?. J Craniomaxillofac Surg. 2020;48:1023-27.

18.Castaño-Joaqui O, Cano-Sánchez J, Campo-Trapero J, Muñoz-Guerra M. TMJ arthroscopy with hyaluronic acid: A 12-month randomized clinical trial. Oral Dis. 2021;27:301-31.

19.Bagis B, Ayaz EA, Turgut S, Durkan R, Özcan M. Gender difference in prevalence of signs and symptoms of temporomandibular joint disorders: a retrospective study on 243 consecutive patients. Int J Med Sci. 2012;9(7):539-44. doi: 10.7150/ijms.4474.

20.Manfredini D, Guarda-Nardini L, Winocur E, Piccotti F, Ahlberg J, Lobbezoo F. Research diagnostic criteria for temporomandibular disorders: a systematic review of axis I epidemiologic findings. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2011 Oct;112(4):453-62. doi: 10.1016/j.tripleo.2011.04.021.

21.Parlawar AN, Mundada BP. Enhancing Pain Relief in Temporomandibular Joint Arthrocentesis: Platelet-Rich Plasma and Hyaluronic Acid Synergy. Cureus. 2023 Sep 20;15(9):e45646. doi: 10.7759/cureus.45646.

22.Macedo de Sousa B, López-Valverde A, Caramelo F, Rodrigues MJ, López-Valverde N. Medium-Term Effect of Treatment with Intra-Articular Injection of Sodium Hyaluronate, Betamethasone and Platelet-Rich Plasma in Pa- tients with Temporomandibular Arthralgia: A Retrospective Cohort Study. Life (Basel). 2022 Oct 29;12(11):1739. doi: 10.3390/life12111739.

22.Morey-Mas MA, Caubet-Biayna J, Varela-Sende L, Iriarte-Ortabe JI. Sodium hyaluronate improves outcomes after arthroscopic lysis and lavage in patients with Wilkes stage III and IV disease. J Oral Maxillofac Surg. 2010 May;68(5):1069-74 doi:10.1016/j.joms.2009.09.039.

23. Xie Y, Zhao K, Ye G, Yao X, Yu M, Ouyang H. Effectiveness of sodium hyaluronate, plasma on temporomandibular joint osteoarthritis: a systematic review and meta-analysis of randomized controlled trials.J Evid Based Dent Pract. 2022 ;22(3):101720.doi:10.1016/j.jebdp.2022.101 720.

24.Stasko J, Statelova D, Janickova M, Mikus- kova K, Bacinsky M, Sokol J, Frlickova Z, Hvizdos D, Malachovsky I. Hyaluronic acid ap- plication vs arthroscopy in treatment of internal temporomandibular joint disorders. Bratisl Lek Listy.2020;121(5):352-357.doi: 10.4149/BLL_2020_056.

25.Gokçe Kutuk S, Gökçe G, Arslan M, Özkan Y, Kütük M, Kursat Arikan O. Clinical and Radiological Comparison of Effects of Platelet- Rich Plasma, Hyaluronic Acid, and Corticoster- oid Injections on Temporomandibular Joint Osteoarthritis. J Craniofac Surg. 2019 Jun;30(4):1144-1148. doi: 10.1097/SCS.0000000000005211.

26.Ângelo DF, Prior A, Cardoso HJ. Postoperative Recovery after TMJ Arthroscopy: Masticatory Improvement and Postoperative Diet. Oral. 2023 May 3;3(2):191-202.

27.Silva PA, Lopes MT, Freire FS. A prospec- tive study of 138 arthroscopies of the temporomandibular joint. Braz J Otorhinolaryngol. 2015 Jul-Aug;81(4):352 7.doi: 10.1016/j.bjorl.2014.08.021. Epub 2015 Jun 9.

28.Gabler MJ, Greene CS, Palacios E, Perry HT. Effect of arthroscopic temporomandibular joint surgery on articular disk position. J Crani- omandib Disord. 1989 Fall;3(4):191-202. PMID: 2639156.

29.González-García R, Monje F. Complications of temporomandibular joint arthroscopy. A criti- cal appraisal of the literature. J Craniomaxillofac Surg. 2024 Oct;52(10):1122-1132. doi: 10.1016/j.jcms.2024.06.018. Epub 2024 Jun 12.